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Individual, Household, and Community U.S. Migration Experience and Infant Mortality in Rural and Urban Mexico

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Abstract

This study explores rural and urban differences in the relationship between U.S. migration experience measured at the individual, household, and community levels and individual-level infant mortality outcomes in a national sample of recent births in Mexico. Using 2000 Mexican Census data and multi-level regression models, we find that women's own U.S. migration experience is associated with lower odds of infant mortality in both rural and urban Mexico, possibly reflecting a process of healthy migrant selectivity. Household migration has mixed blessings for infant health in rural places: remittances are beneficial for infant survival, but recent out-migration is disruptive. Recent community-level migration experience is not significantly associated with infant mortality overall, although in rural places, there is some evidence that higher levels of community migration are associated with lower infant mortality. Household- and community-level migration have no relationship with infant mortality in urban places. Thus, international migration is associated with infant outcomes in Mexico in fairly complex ways, and the relationships are expressed most profoundly in rural areas of Mexico.

Introduction

Somewhere between 324,000 and 440,000 Mexicans migrated to the United States each year between 1990 and 2000 (Hill & Wong, 2005). Money remitted back to Mexico from these U.S. migrants increases the income of receiving households significantly and has indirect effects on non-receiving households as well (Taylor, 2004). Nationally, two billion dollars remitted annually to Mexico in the early 1990's resulted in \$6.5 billion in productive investment and \$5.8 billion in added income (Durand, Parrado, & Massey 1996). Social remittances, or the transfer of information and behaviors from the country of migration to the country of origin (Levitt, 1998), have altered the cultural norms, such as gender roles (Hirsch, 1999), of rural Mexican communities. Thus, the immigration of Mexicans to the United States contributes to social changes in and the economic development of Mexican migrant-sending communities through multiple avenues.

The infant mortality rate is a standard indicator of socioeconomic development because infants are so dependent upon their environments (Mosley & Chen, 1984). If international migration influences socioeconomic development through financial and social remittances, then migration may also lower infant mortality in sending communities. Past research has shown that both household and community migration experience are associated with lower odds of

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infant mortality in a small sample of communities in the center-west region of Mexico (Kanaiaupuni & Donato, 1999) and that household migration experience is associated with lower odds of infant mortality in a national sample (Hildebrant & McKenzie, 2005). Related research has documented a positive relationship between household migration experience and infant birthweight in Mexico (Hildebrant & McKenzie, 2005; Frank, 2005; Frank & Hummer, 2002).

We extend this past work by analyzing the relationship between infant mortality outcomes in Mexico and the international migration experience of Mexicans in two ways. First, we examine differences in the association between infant mortality outcomes and migration experience by level of urbanization in Mexico. Because international migration patterns, health profiles, and levels of economic development differ greatly between rural and urban places in Mexico, it is likely that the relationship between infant mortality and migration also differs by level of urbanization. Specifically, the relationship between household level migration—receipt of remittances and the departure of household members through emigration—and the risk of infant mortality is likely stronger in rural places than in urban places. By using national data and focusing on rural-urban differences, we contribute to a growing body of literature that explores different causes and consequences of migration across different migrant-sending contexts (see for example Fussell and Massey, 2004).

Second, we consider the relationship between the mother's own migration experience and infant mortality, net of household-level and community-level migration variables. To the extent that infant health is improved through the resources that migrant family and community members access through migration (Frank & Hummer, 2002), infants born to women with recent migration experience may benefit from the same resources their mothers accessed through migration. Moreover, migrants may be a selectively healthy group, such that the health of women with U.S. migration experience living in Mexico may be quite different from the health of women in Mexico without migration experience (Palloni & Morenoff, 2001), potentially resulting in a survival advantage for infants of return migrant women in Mexico. We test whether infants born to women in Mexico with recent U.S. migration experience have different survivorship during their first year of life than infants born to women in Mexico without recent U.S. migration experience.

We begin with a review of the literature, focusing separately on the relationships between infant mortality and individual-level, household-level, and community-level migration experience, and how these relationships might differ between rural and urban places in Mexico. We then detail our data, measures, and methods before describing our results. Finally, after explaining the results of our statistical analyses, we conclude with a discussion of our study limitations and some suggestions for future work.

Women's migration experience and infant mortality

Over time and when coupled with remittances, the migration of family members from Mexico to the United States is beneficial to infants who remain in Mexico (Hildebrant & McKenzie, 2005; Frank, 2005; Frank & Hummer, 2002; Kanaiaupuni & Donato, 1999). Women migrants may also gain financial resources through their own migration to the United States that help protect their children against adverse health outcomes. Furthermore, given that women may invest those resources more directly in their own and their children's health, their infants may benefit more from their mother's migration than from their father's migration (e.g. see Donato, Kanaiaupuni, & Stainback, 2003).

Another explanation for the association between international migration and favorable health is that migrants are generally healthier than non-migrants; that is, migrants are a selectively healthy group. The risk-taking, resources, and physical fitness demanded of migration may

yield a group—migrants—who are different from non-migrants in a number of ways that could be associated with health. Healthy migrant selectivity is a major explanation for the relatively good health and mortality outcomes of Mexican Americans compared to other major racial/ethnic groups in the United States (Palloni & Morenoff, 2001; Hummer et al., 1999; see also Landale, Oropesa, & Gorman, 2000). In addition to comparatively good rates within the United States, healthy migrant selectivity explains in part why the infant mortality rate of Mexican immigrant women in the United States is so much lower than the Mexican infant mortality rate. For example, the Mexican National Population Council estimates that the infant mortality rate in Mexico in 2000 was 23.3 deaths per 1000 live births (CONAPO 2004). In the United States, the infant mortality rate for babies born to Mexican immigrant women between 1995 and 2000 was 5.1 deaths per 1000 live births (Hummer et al., 2007).

In this analysis we test how the survivorship of infants born in Mexico to return migrants from the U.S. compares to infants born to women who have not migrated to the United States in order to assess whether women's own migration experience is associated with infant mortality in Mexico. Given that men's migration is associated with positive outcomes for Mexican infants, and theory and evidence suggesting that women migrants are selectively healthy, we expect that infants born in Mexico to women with U.S. migration experience will have lower odds of mortality than will infants born in Mexico to women without U.S. migration experience. Because this health selectivity is largely independent of sending context—that is, both rural-origin and urban-origin migrants are selectively healthy—we expect to see the beneficial relationship between mother's own migration experience and infant mortality in both rural and urban places.

Household-level migration experience and infant mortality

Research on migration and infant health in Mexico has primarily focused on migration experience at the household level. This focus is partly due to data constraints—few data sets have samples large enough to facilitate testing the relationship between women's return migration and infant mortality, two relatively rare events. An emphasis on the household also stems from the theoretical perspective on the causes of migration called the new economics of migration, which understands migration as a household-level strategy to minimize economic risk through income diversification and to gain access to otherwise unavailable capital (Massey & Espinosa, 1997; Stark & Levhari, 1982). This theoretical perspective explains why household migration experience might impact the health of non-migrants back home. If migration is a beneficial household economic strategy, its benefits will be shared by migrants and non-migrants alike.

Empirical research has documented that household migration and the remitting of income back to Mexico are associated with infant mortality, but whether household migration is beneficial or deleterious is unclear. For example, more extensive U.S. experience of the household head is associated with lower odds of infant mortality in Mexico; however, frequent trips to the United States are associated with increased odds of infant mortality, suggesting that U.S. experience may be beneficial for infant health, but only on balance with minimal disruption from migrant departures (Kanaiaupuni & Donato, 1999). Similarly, in a study that accounts for the historical experience of migration in Mexican sending places, household migration is found to be beneficially associated with both infant birthweight and risk of mortality (Hildebrandt & McKenzie, 2005). Infants born into households receiving financial remittances also have lower odds of low birthweight than infants born into households without any U.S. migration experience (Frank & Hummer, 2002). The impact of remittances is not consistently beneficial, however; women receiving remittances for less than a year have higher odds of having a low birthweight infant, while women whose husbands have been remitting for more than a year are less likely to have a low birthweight infant (Frank, 2005). These findings suggest

that migration may have a beneficial effect on infant health through the financial and social resources that migrants obtain in the United States and remit back to Mexico, but that the effect is contingent on some level of migration stability and minimal household disruption from migration.

Because recent migrant trips are disruptive, but remittances have a beneficial effect on health if they are accessed directly by mothers, we expect that infants born to women directly receiving a significant amount of remittances will have lower odds of mortality, but infants born in households with recent out-migration will have higher odds of mortality. Because rural places are more dependent on migrant remittances and their social structures are more densely associated with migrant networks (Lindstrom, 1996; Fussell and Massey, 2004), we expect the effects of household-level remittances to be greater in rural places.

Community-level migration experience and infant mortality

The relationship between community-level migration experience and infant survivorship ties into a broader debate about migration and development in migrant-sending communities. As a community gains migration experience, resources remitted back into that community lead to its economic development through rising incomes, which incur increased consumption, production, and investment (Durand et al., 1996). The infant mortality rate is a standard indicator of a population's well-being and a country's development because infants are so dependent upon environmental factors such as sanitation, nutrition, and quality of and access to medical care (Mosley & Chen, 1984). Thus, a positive association between community migration experience and infant survivorship lends indirect support to the argument that migration leads to development in sending communities.

Kanaiupuni and Donato (1999) explored the relationship between community migration experience and infant mortality in a small sample of communities in the center-west region of Mexico using two measures of community migration experience—the proportion of community members with migration experience and migration institutionalization, defined as the years since the community reached the median level of migration experience. They found that community-level migration experience is associated with lower odds of infant mortality, but only after twenty years of migration institutionalization. Before twenty years of institutionalization, community-level migration experience is associated with higher odds of infant mortality. Thus, the benefits of migration at the community level for infant survivorship are felt in the long term but not in the short term.

Based on empirical research regarding the developmental potential of migration in migrant-sending communities, and research showing a beneficial association between community-level migration prevalence and infant mortality, we expect that infants born in Mexican communities with higher levels of migration experience will have lower odds of mortality. Because the developmental potential of migration is greater in rural places marked by lower levels of development and longer histories of migration, we expect this effect to be greater in rural places.

Rural and urban differences in Mexico

As we've suggested already, we expect to observe differences in the relationship between migration and infant mortality between rural and urban places. While healthy migrant selectivity, resulting in a beneficial association between women's migration and infant mortality, is likely to occur throughout Mexico regardless of level of urbanization, migration, health, and development patterns differ between rural and urban places in ways that suggest that the relationship between household- and community-level migration experience and infant mortality most likely differs between rural and urban places.

Migration from urban Mexico to the United States is a relatively recent phenomenon, whereas high levels of migration from Mexican rural areas to the United States have been ongoing for over half a century (Durand, Massey, & Zenteno, 2001). Thus, rural places are more likely to have achieved migration institutionalization. Urban places are far more economically developed than rural places in Mexico, and a rising disparity between rural and urban places in Mexico throughout the 1980's and early 1990's contributed to increasing inequality overall in Mexico (Bouillon, Legovini, & Lustig, 2003). The extent to which migrants invest their remittances productively, which leads to community economic development, depends on the social and economic context of the local sending area (Durand et al., 1996; Lindstrom, 1996). Because rural places are underdeveloped relative to urban places, remittances make up a greater portion of a community's resources in rural places and will have a greater impact on its development.

Thus, the risk of infant mortality will be more sensitive to the development generated by migrant remittances in rural places. Finally, the health of rural and urban populations differs. One-half of all deaths to rural people in Mexico in 1981 were due to causes such as infectious disease, while lower social class workers in urban areas were more likely to die from causes such as heart or lung disease (Frenk et al., 1989: Figure 3). Small steps towards development in rural places may have a larger impact on infant mortality to the extent that infectious and parasitic diseases can be attenuated through basic development and medical improvements.

Data, measures and methods

Data for this study are drawn from the 2000 Mexican General Census of Population and Households long form, which included a migration supplement, and which was administered to approximately 10 percent of all Mexican households in February 2000 (INEGI, 2003). The 10 percent sample is representative at the state and municipal district levels. We restrict our sample to the 896,148 women between the ages of 15 and 49 who are not missing information on our key independent (i.e. migration) and dependent (i.e. infant mortality) measures. Cases with missing birth or death information on the last child born (2.5 percent of childbearing-aged women) or missing migration information (.22 percent of childbearing-aged women) were excluded from the analysis.

The key outcome measure is the survivorship, through age 1, of the last child born. Infants whose age at death was less than twelve months were coded 1; those who survived through 12 months were coded 0.¹

Women's own migration experience comes from the basic long form of the Census, which asks where each member in the household lived in 1995. All women who reported that their place of residence in 1995 was the United States are coded as return migrants. This measure captures only a portion of return migrant women living in Mexico in 2000 because other women may have lived in the U.S. at different points in time, either prior to or after 1995. The migration supplement of the long form additionally asks about all household members, present or absent in 2000, who migrated between 1995 and 2000, but it is not possible to accurately merge individual information from the long form of the Census with information from the migration supplement because unique identifiers are not provided. Thus, our individual-level migration experience variable for women only captures those who reported living in the U.S. in 1995 and were living in Mexico in 2000. We discuss this limitation further in our conclusion.

¹The long form of the Mexican Census asks for the age at death in days if less than one month, in months if less than one year, and in years if more than one year. As a consequence, it is impossible to determine the extent of age heaping at one year; all children whose mothers reported their child's age at death between 12 and 23 months are coded the same way (=1 year). We are unable to determine and account for the extent to which mothers whose children died at 10 or 11 months reported the age at death as one year. We have no reason to believe that this age heaping would systematically vary by mother's, household, or community migration experience, however.

The long form additionally asks each individual whether they currently receive remittances from abroad and how much they receive. The measure we use for remittances is a two-category indicator of whether mothers report receiving a significant amount of remittances or not, with a significant amount defined as at least 50 percent of their total income or, if less than 50 percent, at least 1400 Mexican pesos, which converts to U.S. \$130 in 2006 and is roughly equal to a monthly income at the Mexican minimum wage.² Remittances constitute 50 percent of total income for 90 percent of recent mothers in our sample who report receiving remittances. Other specifications of remittances—including a binary indicator of whether the mother reported receiving any remittances at all and a measure of remittances defined continuously—showed similar, but somewhat weaker, effects.

We include a dummy indicator for whether any member of the household has recently migrated to the United States, a second measure of household migration experience. This measure draws from various reports of migration in the Census, including the individual migration histories tabulated in the migration supplement and merged to our mothers file through a unique household ID number; the reports of U.S. location in 1995 collected on the individual long form for all household members; and reports on the long form of a U.S. work location for any household member. The categories are zero recent migrants or one or more recent migrants.

The smallest representative geographical units identified in the sample of the Mexican population census are municipalities. We therefore use municipal boundaries to construct our community-level measures. Mexican municipalities are roughly equivalent to counties in the United States, although they are somewhat smaller. In 2000, there were 2442 Mexican municipalities nationwide with an average population of 39,903. Our measure of community migration experience draws from the migration supplement, which gathers information on the U.S. trips of all household members between 1995 and 2000. Thus our community migration experience measure is the proportion of adults with recent migration experience to the United States of the total number of adults in the municipal district.³ Because our measures of migration experience rely on migrant trips between 1995 and 2000, and our measure of infant mortality is based on births in that same period, we cannot address the time ordering of events that might indicate a direct causal connection between migration processes and infant mortality. Thus, we report associations uncovered between the various measures of migration and infant mortality outcomes.

We include a number of covariates that are associated with both infant mortality and migration. Separate dummy variables were created for missing information on each categorical variable; these were included as control variables in the regression models. We do not report the coefficients on these missing controls for the sake of parsimony. In the case of continuous variables, we do not have missing information. For example, our sample was defined based on the age of the mother, and so women missing age information were excluded from the sample altogether.

Mother's age at the time of birth is measured continuously, and we include a quadratic term to account for the non-linear association between mother's age and infant mortality (i.e., higher risk of mortality among younger and older mothers [Mathews, Menacker, & MacDormand,

²Gender structures the household political economy, such that not all members benefit equally from household remittances (Grasmuck & Pessar, 1991). In exploratory analysis, we did not find an association between household-level remittances and infant mortality unless we limited the measure to remittances received directly by the mother. The relationship between household migration experience and infant mortality is therefore tempered by mothers' access to the resources remitted by migrants.

³This is not the same measure used by Kanaiaupuni and Donato (1999) or in most other analyses of community migration prevalence using Mexican Migration Project data (e.g. Massey & Espinosa, 1995). The Mexican Migration Project measure is the proportion of the community population with any migration experience to the United States. The Census only asks about migration experience between 1995 and 2000 and thus captures the proportion of community adults with recent migration experience. This measure has been used by other scholars; for example, see Kandel and Massey's (2002) analysis of the culture of migration and student aspirations.

2004]). Marital status is a categorical indicator for currently married (either by the state or church), cohabiting, separated, divorced, widowed, or single. To measure parity, we use the Kleinman-Kessel Parity Index (Kleinman & Kessel, 1987), which accounts for the interaction between mother's age at birth and birth order. The Index distinguishes first births from low parity (second-order births to women 18 and older, third- or higher-order births to women 25 and older) and high parity (second- or higher-order births to women under 18, third- or higher-order births to women under 25, and fourth- or higher-order births to women 25 and older). A dichotomous indicator distinguishes women who report speaking an indigenous language.

Three measures capture socioeconomic status. The first is an indicator for whether the mother has health insurance coverage at the time of the survey. Public health insurance coverage in Mexico depends on employment in the formal economy, so this measure simultaneously captures some degree of economic stability and access to health care. The second is mother's education, categorized as no education, some or all primary education, some or all junior high education, or some high school or higher. The third is the household's poverty status, a composite index of eight indicators of poverty, based on the Mexican Population Council's Index of Marginalization (CONAPO, 2000). The eight components include whether a household has dirt floors, does not have indoor plumbing or a private toilet, does not have electricity, does not have access to piped water, and has more than two people per room; and whether the household head is illiterate, has not completed primary education, and does not earn more than two minimum daily wages. Our calculation of the minimum wage is based on the household head's reported monthly income divided by 20 work days per month and the national minimum daily wage for three wage zones in Mexico (see <http://www.sat.gob.mx/nuevo.html>). This composite index is a better measure of poverty than one based solely on wages because many Mexican rural residents are engaged in non-monetary forms of wealth generation. The Cronbach's alpha score for our constructed household poverty index is .68. We also include a continuous measure of the number of people residing in the household, based on the household roster.

Three indicators measure broader geographic and socioeconomic context. In the analysis of the entire national sample, we distinguish between rural places (<2500 people) and urban places (≥ 2500 people). The cutoff at 2500 is the most common international definition of rural and urban areas (United Nations, 2000); it is the definition used by both the U.S. Census Bureau (see http://www.census.gov/geo/www/ua/ua_2k.html) and the Mexican National Institute of Geography and Statistics (Villalvazo Peña, Corona Medina and García Mora, 2002).

A regional indicator groups together states with similar migration histories (Durand, Massey, & Zenteno, 2001). The four regions are the historic region in central-western Mexico, the border region, the central region, and the southeastern region. Finally, the Mexican Population Bureau's Index of Marginalization measures community poverty; it is standardized and normally distributed (CONAPO, 2000). This index uses the same eight indicators of poverty as the household level measure except the indicators are measured based on the percentage of municipal households meeting each criterion.

We first show frequency distributions and means of each variable for the entire sample and separately by level of urbanization. Two-level hierarchical generalized linear models with random level-two intercepts (Raudenbush & Bryk, 2002) were estimated using HLM 6.0 software (Raudenbush, Bryk, & Congdon, 2004) to account for the nested nature of our data (i.e., women within communities). Multilevel models are necessary because women living in the same communities may be exposed to similar factors affecting the risk of infant mortality. Our models allow us to specify separate individual- and community-level error terms. Because over 93 percent of women were located in separate households, we did not separate individual

and household error terms in our analysis. We employed level-one weights in our analysis to account for the sampling structure (including an oversample of rural households).

Descriptive results

Table 1 shows the descriptive statistics for the variables included in our regression models. The estimated infant mortality rate in our complete sample is 12.8 deaths per 1000 live births. This is substantially lower than reported estimates of the IMR in Mexico around 2000. For example, the Mexican National Population Council estimated the IMR in 2000 to be 23.3 (CONAPO 2006).⁴ We estimate that the rural infant mortality rate is 50 percent higher than the urban mortality rate (17.2 versus 11.2), a nearly identical rural-urban ratio to the one reported by CONAPO for 1990–1995 data.⁵

The mean age at birth of our sample is 25.9 years, and this does not vary substantially by level of urbanization. Rural women were slightly more likely than urban women to be married, cohabiting or widowed and slightly less likely than urban women to be separated, divorced, or single. Three times as many urban women as rural women were divorced in 2000, but the overall rates are low for these recent mothers, at less than one percent for the entire sample. Rural women were most likely to have had a high parity birth, while urban women were most likely to have had a low parity birth. About one-third fewer rural women had a first birth than urban women in this sample of most recent births reported in 2000. Fifteen percent of rural women reported speaking an indigenous language, whereas fewer than five percent of urban women did. Rural mothers in Mexico were far less educated than urban mothers: three-fourths of rural women had a primary school education or less, whereas only just over one in three urban women did. Urban women, on the other hand, were far more likely to have reported a high school or higher education. The most dramatic difference between urban and rural women is their insurance coverage. A full 80 percent of rural women were uninsured in 2000, whereas half of urban women were. Overall, insurance coverage in Mexico in 2000 was low, at only 58 percent.

Rural households were slightly larger than urban households in our sample, but on average these recent mothers lived in households with four or five additional members. Rural

⁴There are several possible explanations for our low overall estimate of infant mortality using these data. Most likely, both recent births and, in particular, infant deaths are underreported in the Mexican Census survey sample that we use. This is a common pattern in survey-based data such as this. Preston and colleagues (2000: 230) summarize that, “One source of error arises simply from misreport of the number of children ever born and children dead. These numbers are often understated, and it is generally presumed that dead children are more likely to be understated than children surviving, because a dead child is not present to remind the mother of the birth. Women may also have an aversion to mentioning a dead child or referring in any way to his or her absence. Women may also be confused about whether they should count a stillbirth (they should not) or a child that died shortly after birth (they should). These two categories are often not readily distinguished and women’s reports about them show unusually high unreliability.” Despite these limitations and concerns, we have no reason to believe that this underreporting would vary in any systematic way by the individual, household, or community migration status of women in our data.

Some under-reporting of infant mortality could also be due to the fact that one person reports the birth dates and survivorship information for all the women in their households, and they may underreport the deaths of other women’s infants. We tested this possibility by limiting our analytical sample to only household heads and their spouses, who presumably answered the survey, and our results did not change. We were unable to otherwise identify which household member in fact answered the survey. A third possibility is that there may be difficulties in accurately reporting infant deaths because of problems associated with identifying the exact reference period (i.e., deaths occurring before the first birthday) (Preston, Heuveline, and Guillot, 2000). Finally, there is also some evidence that the infant mortality rates of the last child born – as we use here – are generally lower than the infant mortality rate among all children born due to selection biases involving replacement fertility following the recent death of a child (see Preston, Heuveline, and Guillot, 2000: pages 231–232). Despite these limitations and cautions involving the overall level of infant mortality reported in this paper using these data, there is no better available source at present for understanding large-scale patterns of infant mortality by migration status and other social and demographic covariates in Mexico. Further, the correlations that we present in the results section for well known risk factors for infant mortality (e.g., maternal age, maternal education, poverty status, etc.) are perfectly consistent with the huge amount of literature on this topic. For these reasons, we are confident in the results we present regarding correlations between migration variables, other sociodemographic characteristics, and infant mortality in Mexico but, at the same time, provide a cautionary note that we also think the data set is characterized by underestimates of infant mortality for the reasons described above.

⁵See <http://www.conapo.gob.mx/00cifras/00salud/Republica/rm090.gif>.

households scored much higher on the poverty scale than urban households. A higher percentage of rural households were located in the historic and southeast regions of the country. Overall, our sample is 74 percent urban and 26 percent rural.⁶ The mean marginality index, which ranges between -3 and 3, with higher value indicating greater marginality, was higher in rural places than in urban places.

Less than one percent of recent mothers reported living in the United States in 1995; rural mothers were slightly more likely to be return migrants than urban mothers. Just over three percent of rural women reported receiving a significant amount of remittances, twice the proportion of urban women. One in ten rural households reported that at least one household member migrated to the United States between 1995 and 2000; fewer, just under seven percent, of urban households reported a recent out-migration.

Finally, municipalities in Mexico had very low proportions of adults with recent migration experience in 2000, at under one percent for the entire sample. Although municipalities are not entirely rural or urban (rural and urban designations in the Census are based on the size of the household's locality, which is a smaller geographical unit than the municipality; i.e., municipalities may be made up of both rural and urban localities), adults living in rural localities lived in municipalities with a higher proportion of recent migrants than adults living in urban localities.

Multivariate results

Table 2a shows the multivariate results for the complete sample, and we begin by describing the association between infant mortality and the socio-demographic and geographic measures in our models and then move on to a description of our key analytical variables of U.S. migration experience. Infant mortality decreases with mother's age in the middle of the age distribution, but the quadratic term confirms that the relationship is concave—there is a higher risk of infant mortality for younger and older mothers. Cohabitation and single parenthood are associated with higher odds of infant mortality relative to infants born to married mothers. First born children have lower odds of mortality than low parity children, whereas high parity children have 81 percent higher odds of infant mortality than low parity children. Infants born to indigenous and non-indigenous women have the same odds of mortality net of other covariates. Being uninsured is associated with 13 percent higher odds of infant mortality. Lower levels of mother's education are associated with higher odds of infant mortality, with the largest difference apparent between infants born to mothers with no education relative to infants born to mothers with some high school or a higher education, as expected.

Larger household size is associated with lower odds of infant mortality, with each additional household member reducing the odds of infant mortality by 16 percent net of other covariates. Household poverty is associated with higher odds of mortality. One additional point on the household poverty scale increases the odds of infant mortality by 35 percent. Net of other covariates, the risk of infant mortality is statistically equivalent in rural and urban places. There is a lower risk of infant mortality in the border region relative to the historic region, whereas there is a higher risk in the central region. Risk of infant mortality, net of these individual and household characteristics, is the same in the historic and southeastern migration regions of the country.

The size and direction of our covariates do not change substantially with the inclusion of individual, household, and community migration experience, suggesting that the relationships

⁶These estimates are based on the weighted samples and therefore do not correspond to the unweighted totals reported at the bottom of Tables 1 and 2b.

between these socio-demographic and geographic characteristics and infant mortality are not mediated by U.S. migration experience. However, women's, household, and community-level U.S. migration experience are associated with infant mortality in the entire Mexican population, net of socio-demographic and geographic characteristics. Both women's own and community-level U.S. migration experience are associated with lower odds of infant mortality, consistent with our expectations, although the odds ratio for community out-migration only reaches marginal statistical significance. Infants born to women with recent U.S. migration experience have over 40 percent lower odds of mortality in their first year of life than infants born to women without recent U.S. migration experience. This association seems to be mediated very slightly by household-level migration, as the odds ratio reduces from .58 to .55 between models 1 and 2, suggesting that a very small part of the association between women's migration and infant mortality is due to women living in households with other U.S. migrants. The odds ratio for community-level migration experience (.990) represents the change in the odds of infant mortality associated with a 1 percent increase in that measure. Thus, a one percent increase in the community-level migration prevalence is associated with one percent lower odds of mortality. This result only reaches marginal statistical significance.

Models 2 and 3 of Table 2a show a significant, positive association between recent household migration and risk of infant mortality, and a marginally significant, negative association between remittances and infant mortality, consistent with our expectations. Infants born into households with one or more recent U.S. migrants have over seven percent higher odds of infant mortality than infants born into households with zero recent U.S. migrants. Mother's receipt of remittances lowers the odds of infant mortality by about seven percent.

These associations between individual, household, and community-level U.S. migration experience and infant mortality are replicated in the urban sample (first, second, and third columns on Table 2b) and in the rural sample (fourth, fifth and sixth columns of Table 2b). The associations are larger in magnitude in the rural than in the urban sample, consistent with our expectations. That is, the associations between individual, household and community-level migration experience and infant mortality are stronger and more statistically significant in rural than in urban places. In fact, only mother's own U.S. migration experience is significantly associated with the risk of infant mortality in urban Mexico. Although the association is less strong in urban than in rural places, infants born to urban mothers with recent U.S. migration experience have lower odds of mortality in their first year of life. Analyses of an interaction effect between mother's migration status and rural location in the full model showed no significant difference in this relationship between rural and urban mothers (results not shown).

As expected, we observe a stronger and more significant negative relationship between mother's receipt of remittances and infant mortality in rural places than in urban places. In rural places, infants born to women receiving a significant amount of remittances have 20 percent lower odds of mortality in their first year of life. An interaction term introduced into the full model showed that this effect was significantly different for rural and urban mothers (results not shown). Thus, in rural places, the out-migration of household members is deleterious for infant health, but mother's receipt of remittances is beneficial, suggesting that household-level U.S. migration has mixed blessings for the health of non-migrating household members in rural Mexico.

Our measures of socioeconomic status are associated with infant mortality somewhat differentially between rural and urban places, perhaps reflecting the different ways that inequality is expressed in rural and urban Mexico. Whereas being uninsured has a larger association with infant mortality in rural places, education is more strongly associated with infant mortality in urban places. In rural places, there is no significant difference in the risk of mortality between infants born to women with a junior high school versus a high school

education. In urban places, on the other hand, infants born to women with a junior high school education have 24 percent higher odds of mortality than infants born to women with a high school or higher level of education. Insurance status, therefore, seems to be a more relevant marker of socioeconomic difference in rural places, and education is more relevant in urban places, at least for infant mortality. The household poverty index associates more strongly with infant mortality in urban places, but the community poverty index associates more strongly in rural places, suggesting that there is greater variation in poverty between households, but not communities, in urban places, but the reverse is true in rural places.

Conclusions

Using a national sample of recent births in Mexico, we find that the risk of individual-level infant mortality varies by individual and household-level U.S. migration experience, but that the relationship is most strongly felt in rural parts of Mexico. Recent household-level U.S. migration experience is significantly associated with infant mortality in rural, but not in urban, places. Recent individual-level U.S. migration experience is associated with infant mortality in both rural and urban parts of Mexico. This variation by level of urbanization hints at different processes: the health consequences of migration at the household level are more strongly felt in underdeveloped rural places where resources remitted back into sending households have a greater impact than they would in more developed urban places. The marginally significant, beneficial relationship between community-level U.S. migration experience and infant mortality in rural places suggests the same kind of process.

Migrants are a selectively healthy group because of the risk-taking, resources, and physical fitness demanded of the process of migration. The pervasive and robust association for individual-level migration likely reflects a process of healthy migrant selectivity that occurs regardless of level of urbanization. That is, household and community-level migration are associated with infant mortality because of resources remitted back home, with their impact depending on the sending community context as captured here by level of urbanization; individual-level migration is associated with infant mortality because of healthy migrant selectivity, a process that is not dependent on the sending community context.

The health consequences of household-level U.S. migration are observed in rural places, but not in urban places. Specifically, in rural places, infants have lower odds of mortality if their mothers report receiving a significant amount of remittances. Infants have higher odds of mortality if there has been recent migration out of their households. The fact that household-level migration has both beneficial and deleterious relationships with infant health reflects the mixed blessings of migration in rural places: remittances are helpful, but the departure and absence of household members is disruptive. This finding corresponds with other mixed results regarding household-level migration and infant health in past research (Frank, 2005; Frank & Hummer, 2002; Kanaiaupuni & Donato, 1999). It is a reminder that split household migration, as understood by the new economics of migration (Stark & Levhari, 1982), cannot be uniformly characterized as a positive economic strategy or an undesirable option of last resort. Rather, the emigration of household members has mixed blessings for those left behind.

The greater beneficial impact of remittances and community out-migration in rural places is consistent with our expectations. Because rural households have fewer opportunities and resources than urban households in Mexico, remittances likely make up a larger portion of household resources in rural places, and thus they have a stronger beneficial relationship with infant health. Community-level migration most likely functions the same way, although in our models the association does not reach a reliable level of statistical significance. The developmental potential of migration is greater in rural places because the initial levels of development are lower and the sources of development fewer.

One reason we may not see a stronger relationship between community-level migration experience and infant mortality may be our inability to control directly for migration institutionalization. Kanaiaupuni and Donato (1999) show that community-level migration is only beneficial for infant health after a community reaches migration institutionalization; it is at this point that migration is no longer disruptive but normative and that the development benefits of migration begin to be felt. Because Mexican rural communities have a longer history of migration (Durand, Massey, & Zenteno, 2001), by conducting the analysis separately for rural places we may be indirectly controlling migration institutionalization to some extent, which may be why the coefficient in the rural sample approaches significance. That is, the marginally significant, beneficial relationship in rural communities may be partly explained by the institutionalization of migration there.

Because infant mortality is a relatively rare event, it is a difficult outcome to study. In the United States, linked birth-death files facilitate the study of individual-level infant mortality outcomes. Such data do not exist in Mexico. Thus, our analysis is limited to the data that are available to us, despite their limitations. The 2000 Mexican Census asks about the birth and survivorship of the last child born of all women sampled with the long form, and it also asks about the migration of all household members in the past five years. Both measures are problematic. Our estimates of infant mortality are lower than national and international estimates of the Mexican IMR (see endnote 3). However, we do not expect differential reports of infant mortality by migration status systematically bias our results.

Our measure of women's migration status is another limitation. We used information regarding the U.S. location of women in 1995 to identify return migrants from the U.S. to Mexico because we could not accurately merge the individual migration histories with individuals on the household roster. Women may have left Mexico and returned between 1995 and 2000, and we do not capture them with our measure. The lower rate of infant mortality to this particular subset of return migrant women may not be characteristic of other return migrant women, although, again, we have no reason to suspect that these particular return migrant women are unique. The potential influence of a lower rate of infant mortality to other return migrant women who are miscoded due to the limitation of this measure is likely swamped in the larger sample of women without migration experience in Mexico. Overall, then, it is noteworthy that we find an effect of women's migration status, despite the limitations of this measure.

Finally, as with all cross-sectional data, we are unable to determine causal relationships with our analysis. Instead, we uncover associations between our various measures of migration, socio-demographic characteristics, and infant mortality. Because we are relying on births and deaths within the five years prior to the survey, and most data on our covariates reflect characteristics measured in 2000, it is possible that some of our associations in fact convey reverse causation. For example, families may lose their insurance coverage following the death of an infant, rather than the death of the infant being more common among uninsured families. We cannot disentangle these associations with our data, but we do not think that reverse causation could logically explain most of the associations we uncovered.

Future work would ideally use panel data on infant mortality and migration. Collecting birth histories to supplement Mexican and Latin American Migration Projects, which have now extended outside the historic region of Mexico and into other countries in Latin America, would be an ideal way to tackle these relationships more thoroughly. Other data sources, such as the Mexican Family Life Project, may not have sample sizes large enough to analyze infant mortality, but could ask similar research questions using other health outcome measures.

Another avenue of research is to further explore differential impacts of migration on household members by varying community-level characteristics. For example, it is possible that migration

has a different effect on infant mortality in communities marked by greater levels of poverty. Cross-level interactions between individual and community-level characteristics could expand our understanding of these processes.

Despite these limitations, our study contributes to our broader understanding of the relationship between health and migration. Health is related to migration not only in receiving countries, but also in sending countries. Specifically, we show that infant mortality in Mexico is associated with various forms of migration experience, and these associations suggest different meanings and consequences of migration by level of urbanization in Mexico. Given the magnitude of Mexico-U.S. migration and the debate on the developmental potential of migration in sending communities, as well as ongoing interest in the connection between migration and health, these issues continue to deserve further attention.

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Table 1

Weighted Distributions and Means of Variables for Entire Sample and for Rural and Urban Sub-samples

	Entire	Urban	Rural
Infant Mortality Rate			
Deaths in first year of life (per 1000 live births)	12.8	11.2	17.2
Mother's Sociodemographic Characteristics			
Mother's age (mean)	25.9	25.8	26.0
Marital status (%)			
Married	67.6	67.5	68.0
Cohabiting	21.0	20.2	23.3
Separated	4.2	4.4	3.4
Divorced	0.8	1.0	0.3
Widowed	0.9	0.8	1.2
Single	5.4	6.1	3.7
Parity (%)			
First birth	30.5	32.7	24.2
Low parity	39.4	43.0	29.2
High parity	30.1	24.3	46.6
Indigenous Language (%)	6.3	3.0	15.6
Health insurance coverage: Uninsured (%)	58.4	49.9	82.7
Education (%)			
No education	6.1	3.4	13.6
Primary education	39.3	31.4	61.7
Junior high education	27.1	30.4	17.5
High school education or higher	26.7	33.8	6.5
Household Characteristics			
Number of people (mean)	5.7	5.6	6.2
Household poverty index (mean)	0.19	0.13	0.36
Level of urbanization (%)			
Rural	26.1	--	--
Urban	73.9	--	--
Community Characteristics			
Region (%)			
Historic	24.3	23.0	27.9
Border	20.6	23.7	11.9
Center	39.8	41.0	36.5
Periphery	15.3	12.3	23.7
Community marginality index (mean)	-1.01	-1.36	-0.02
Migration Experience			
Individual experience: Mother is a return migrant (%)	0.51	0.49	0.54

	Entire	Urban	Rural
Household experience: Mother receives remittances (%)	2.0	1.6	3.3
Household experience: Household has at least one migrant (%)	7.8	6.6	11.2
Community migration experience (mean %)	0.7	0.3	1.3
Unweighted sample size	896148	528676	367472

* Chi-square tests for equal distributions and F tests for equal means showed significant differences at the $p < .001$ level across rural and urban samples for all variables.

** Sample sizes may not correspond to frequency distribution by level of urbanization because of weighting.

*** Categorical percentage may not add up to 100% because missing data categories are not presented.

Table 2**Table 2a. Odds ratios predicting the likelihood of infant mortality by mother's, household, and community migration experience in Mexico**

	Entire Sample		
	Model 1	Model 2	Model 3
Mother's Socio-Demographic Characteristics			
Mother's age (years)	0.878 ***	0.879 ***	0.879 ***
Mother's age squared	1.003 ***	1.003 ***	1.003 ***
Marital status (ref=married)			
Cohabiting	1.151 ***	1.152 ***	1.151 ***
Separated	0.987	0.987	0.987
Divorced	1.185	1.185	1.184
Widowed	0.887	0.888	0.888
Single	1.567 ***	1.565 ***	1.566 ***
Parity (ref=low parity)			
First birth	0.696 ***	0.695 ***	0.696 ***
High parity	1.814 ***	1.814 ***	1.814 ***
Indigenous Language	0.970	0.971	0.969
Health insurance coverage (ref=insured)			
Uninsured	1.131 ***	1.129 ***	1.130 ***
Education (ref=some high school)			
No education	1.665 ***	1.667 ***	1.667 ***
Primary education	1.494 ***	1.494 ***	1.495 ***
Junior high education	1.261 ***	1.261 ***	1.262 ***
Household Characteristics			
Number of people	0.835 ***	0.835 ***	0.835 ***
Household poverty index	1.352 ***	1.358 ***	1.353 ***
Community Characteristics			
Level of urbanization (ref=urban $\geq$ 2500)			
Rural (<2500)	0.989	0.988	0.992
Geographic location (ref=historic)			
Border	0.869 *	0.873 *	0.868 *
Center	1.144 ***	1.149 ***	1.142 **
Periphery	0.941	0.947	0.934
Community marginality index	1.043 **	1.043 *	1.045 **
Migration Experience			
Mother is a return migrant	0.577 ***	0.548 ***	0.547 ***
Mother receives remittances		0.925 †	0.926 †
Household has recent migration		1.076 *	1.083 **

Table 2a. Odds ratios predicting the likelihood of infant mortality by mother's, household, and community migration experience in Mexico

	Entire Sample		
	Model 1	Model 2	Model 3
Community out-migration			0.990 [†]
Level 1 Sample Size	896148	896148	896148
Level 2 Sample Size	2412	2412	2412

Table 2b. Odds ratios predicting the likelihood of infant mortality by mother's, household, and community migration experience in the rural and urban sub-samples of Mexico

	Urban Sub-sample			Rural Sub-sample		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Mother's Socio-Demographic Characteristics						
Mother's age (years)	0.861 ***	0.861 ***	0.861 ***	0.900 ***	0.902 ***	0.902 ***
Mother's age squared	1.003 ***	1.003 ***	1.003 ***	1.002 ***	1.002 ***	1.002 ***
Marital status (ref=married)						
Cohabiting	1.160 ***	1.160 ***	1.160 ***	1.132 ***	1.134 ***	1.132 ***
Separated	1.058	1.058	1.057	0.870 [†]	0.871 [†]	0.870 [†]
Divorced	1.207	1.207	1.206	1.159	1.161	1.159
Widowed	0.815	0.814	0.814	0.932	0.934	0.934
Single	1.643 ***	1.644 ***	1.644 ***	1.464 ***	1.460 ***	1.461 ***
Parity (ref=low parity)						
First birth	0.613 ***	0.613 ***	0.613 ***	0.831 ***	0.829 ***	0.829 ***
High parity	1.801 ***	1.801 ***	1.801 ***	1.844 ***	1.846 ***	1.845 ***
Indigenous Language	1.012	1.013	1.011	0.945	0.946	0.944
Health insurance coverage (ref=insured)						
Uninsured	1.085 *	1.083 *	1.084 *	1.191 ***	1.188 ***	1.190 ***
Education (ref=some high school)						
No education	1.692 ***	1.693 ***	1.693 ***	1.348 ***	1.350 ***	1.351 ***
Primary education	1.536 ***	1.536 ***	1.537 ***	1.206 **	1.207 **	1.209 **
Junior high education	1.238 ***	1.238 ***	1.238 ***	1.106	1.106	1.107
Household Characteristics						
Number of people	0.836 ***	0.837 ***	0.837 ***	0.832 ***	0.831 ***	0.831 ***
Household poverty index	1.579 ***	1.578 ***	1.576 ***	1.221 **	1.228 **	1.222 **
Community Characteristics						
Geographic location (ref=historic)						
Border	0.876 [†]	0.873 [†]	0.866 [†]	0.852 *	0.856 *	0.852 *
Center	1.139 *	1.142 *	1.135 *	1.143 ***	1.148 ***	1.140 **

Table 2b. Odds ratios predicting the likelihood of infant mortality by mother's, household, and community migration experience in the rural and urban sub-samples of Mexico

	Urban Sub-sample			Rural Sub-sample		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Periphery	0.839 *	0.842 *	0.832 *	0.989	0.997	0.981
Community marginality index	1.037	1.036	1.038	1.066 **	1.066 **	1.068 **
Migration Experience						
Mother is a return migrant	0.685 **	0.676 **	0.676 **	0.444 **	0.414 **	0.415 **
Mother receives remittances		1.062	1.064		0.803 **	0.804 **
Household has recent migration		1.006	1.008		1.124 **	1.137 **
Community out-migration			0.989			0.989 †
Level 1 Sample Size	528676	528676	528676	367472	367472	367472
Level 2 Sample Size	1512	1512	1512	2379	2379	2379

† marginally significant at .10;

* significant at .05;

** significant at .01;

*** significant at .001